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ABSTRACT

American technical and economic preeminence are reported to be at risk from students' diminished intellectual ability, demonstrated until recently by declining precollege test scores. But aptitude gains are also reported. Average intelligence quotient rose substantially for persons born between 1900 and 1967, although IQ declined for those born in the depression and postwar baby boom. Time-series regression shows that 80% of the variation in cohort IQ over time can be explained by variation in early childhood nutrition and family size. Improving the environment of the first years of life seems a key to increasing the intellectual capability and productivity of Americans. (Author)

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A Nation at Risk?

IQ and Environment in the 20th Century

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Abstract

American technical and economic preeminence are reported at risk from diminished intellectual ability, demonstrated until recently by declining precollege test scores. But aptitude gains are also reported. Average intelligence quotient rose substantially for persons born between 1900 and 1967, although IQ declined for births in the depression and postwar baby boom. Time-series regression shows that 80% of the variation in cohort IQ over time can be explained by variation in early childhood nutrition and family size. Improving the environment of the first years of life seems a key to increasing the intellectual capability and productivity of Americans.

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[Supporting papers attached:
Franke, R. H. (1984). A nation at risk? Time-series analysis seeking explanation of decline and rise in national SAT scores.
Franke, R. H., and Paduch, P. J. (1984). Environmental sources of intelligence differences among separated identical twins.
Both papers presented, APA, Toronto.]

A Nation at Risk?
IQ and Environment in the 20th Century

Richard H. Franke

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Summary

This study provides average aptitude scores of Americans born between 1900 and 1967, explains aptitude differences by differences in the environment experienced during early childhood, and projects aptitude averages to the the end of the century.

There are numerous reports of recent decline in the aptitude of Americans. Most prominently, the National Commission on Excellence in Education (1983) warned that preeminence of the United States is at risk as competing nations come to rival it in science, technology, industry, and commerce. Competitive deterioration was attributed to the erosion of educational excellence and thus of intellectual ability, as indicated by the 1963 to 1980 decline of high school student scores on the Scholastic Aptitude Test.

However, a review of restandardization samples by James Flynn (1984) reported that average intelligence quotients of white Americans on Stanford-Binet and Wechsler tests (aptitude scores adjusted for age) have risen during much of the 20th century. Intelligence quotient levels can be calculated from Flynn's data by organizing gains according to birth years and establishing an IQ basis of 100 for cohorts born about 1900. National averages are presented in Figure 1A as dots, circles, triangles, and points (for restandardization samples sizes over

400, 140, 70, and 30). A rate of gain of 0.325 points per year is shown by the straight line regression of IQ on year of birth, which is affected little by exclusion of data from smaller samples. IQ rose at about this rate from birth year 1900 to 1937/38, except for a drop in 1935 at the depth of the depression. There appears to have been a sharp increase of IQ for births following the depression to a peak for births in world war II. Average IQ declined some 9 points for those born during the post-war baby boom up to 1962, subsequently recovering about 5 points for birth years up to 1967.

Insert Figure 1 about here

Declines of aptitude between the scores of those born in the 1940s and the scores of persons born up to the early 1960s are shown by both Scholastic Aptitude Test averages (Franke, 1984) and by the intelligence quotients of Figure 1A. But there are also IQ increases from birth years about 1900 until the depression and from births toward the end of the depression until world war II. In terms of individual standard deviations (about 15 IQ points), the relative IQ levels in Figure 1A show well over a standard deviation's rise of aptitude between persons born about 1900 and those born in the 1940s. Less than half of this long-term gain was lost during the postwar baby boom, as shown by SAT and IQ declines for births from the 1940s to the early 1960s. Some recovery of average aptitude following the baby boom is seen in rising SAT and IQ scores for birth years between 1962 and 1967.

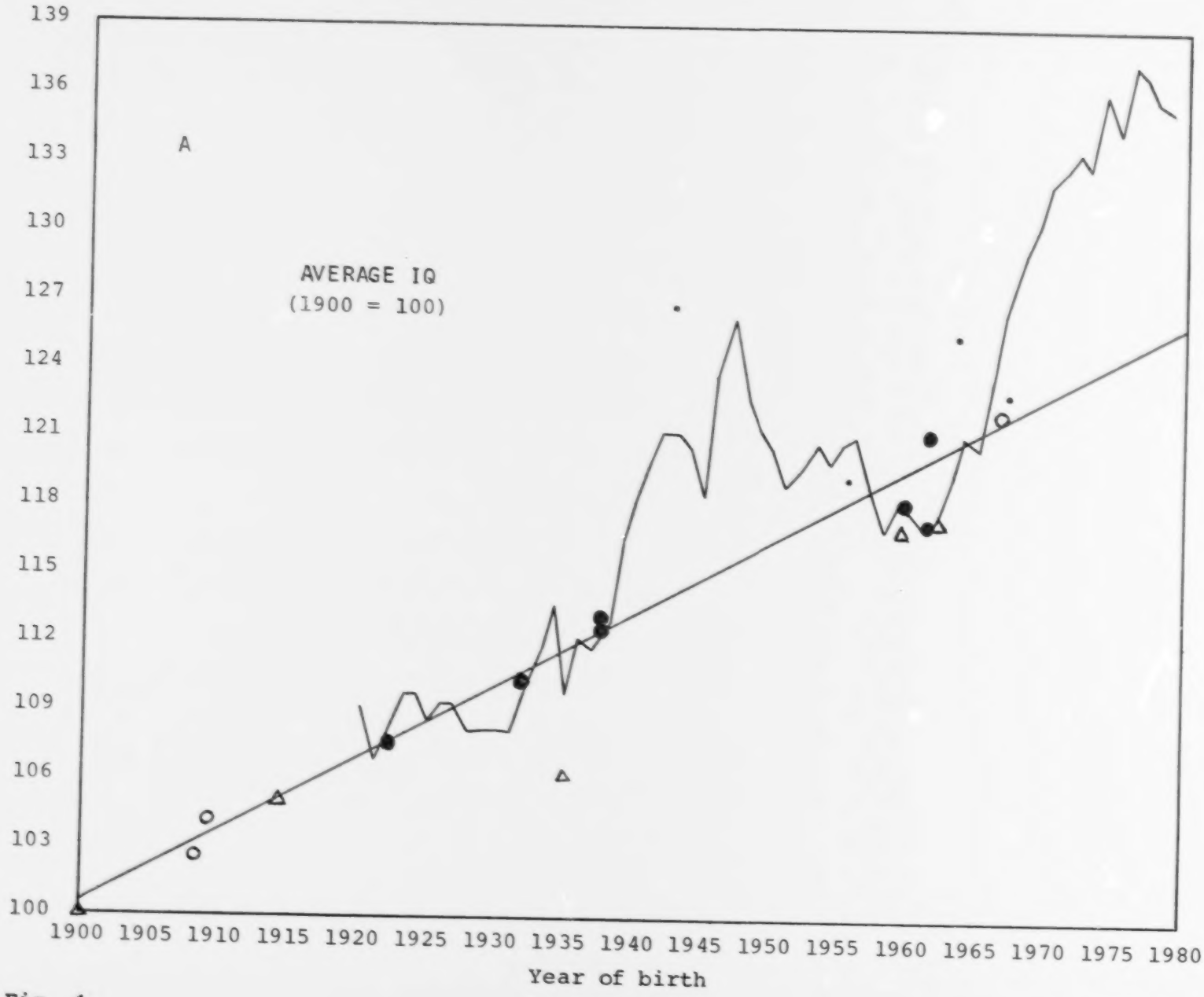
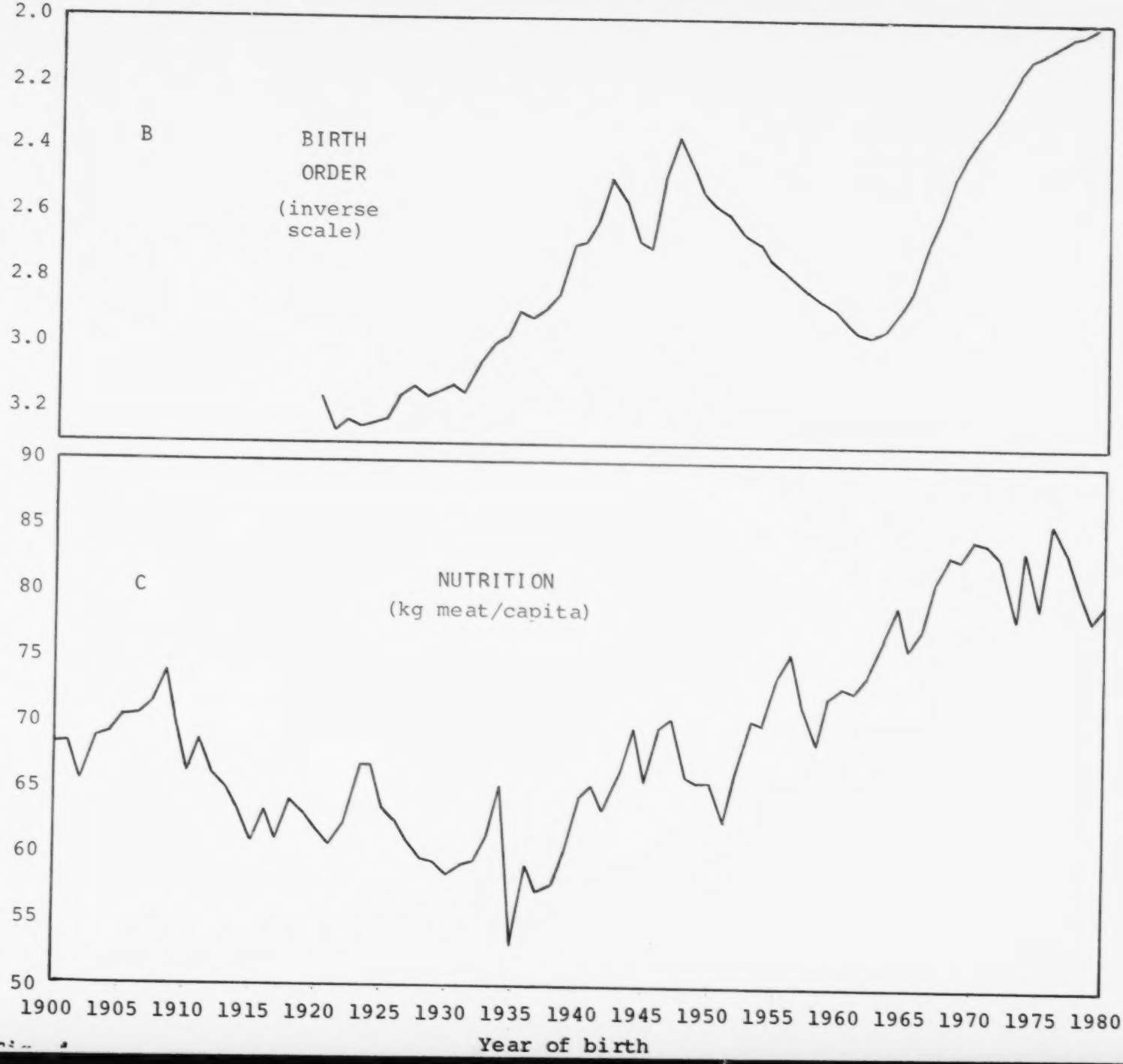

A
AVERAGE IQ
(1900 = 100)
139
136
133
130
127
124
121
118
115
112
109
106
103
100
1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980
Year of birth

Fig. 1.


2.0
2.2
2.4
2.6
2.8
3.0
3.2
B
BIRTH
ORDER
(inverse
scale)
90
85
80
75
70
65
60
55
50
C
NUTRITION
(kg meat/capita)
1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980
Year of birth

Dilution theories propose that families have limited economic and parental time resources and that children's intellectual development can be affected adversely through resource dilution by greater numbers of siblings (Anastasi, 1956; Heer, 1985). In their "confluence model," Zajonc and Markus (1975) hypothesize that the mental stimulation of young children is aided more by contact with intellectually developed adults than by the contact with other young children which predominates in large families, especially for children who are closely spaced and later born. Relationships to individual aptitude have been evaluated in a variety of settings, with controls for factors such as occupational background and socio-economic status of parents. But due to substantial genetic and other differences, even within the same biological family, cross-sectional studies often explain only a few percent of the variance in individual intelligence on the basis of differences in family size and birth order (Grotevant et al., 1977).

Strong support for the influence of family size upon intellectual development is provided in evaluations which are not confounded by individual genetic differences. A cross-sectional analysis of IQ differences between identical twins adopted by different families shows eventual intelligence to be related negatively to the number of siblings in the adopting family (Franke and Paduch, 1984). A longitudinal study tracing IQs of individuals over time shows the intellectual development of young children to be diminished by the birth of additional siblings (McCall, 1984). For the present analysis, genetic changes from year to year in a large population such as that of

the United States should be gradual and slight, so that effects of family and other environmental changes could be seen in the analysis of national aptitude over time.

Another environmental factor which could inhibit the rate of intellectual development is the availability in childhood of key nutrients. Malnutrition due to insufficient consumption of relatively expensive protein may affect the intellectual development of young children. While average levels of protein consumption in the United States have been more than adequate in this century, even during the depression, nutrition for those in lower economic strata is often well below average, and especially in periods of economic contraction lower levels of consumption can jeopardize intellectual development (cf. Brown, 1985; Franke and Barrett, 1975).

The relative intelligence quotients in Figure 1A are related inversely to the average family size at birth (birth order) for white Americans and positively to the average per-capita availabilty of meat at the time of birth, presented in Figure 1B and 1C. Relative IQ rose from the level of 100 set for 1900 to 107.5 in 1922. Average IQ levels of those born after 1922, when data begin for family size at birth, changed roughly as expected if family size were the sole explanatory factor. The IQ increase of 19 points from 1922 to 1942/43 was for a white population whose average family size at birth declined from 3.08 in 1922 to a minimum of 2.36 in 1942. In the baby boom after world war II, average IQ declined about 9 points for those born as family size rose to a peak of 2.81 in 1962. The subsequent drop of average family size to 2.49 by

1967 was associated with a rise of about 5 points in average IQ. In addition, changes in IQ were related to changes in average nutrition at the time of early childhood. The drop of 4 IQ points between births in 1932 and 1935 could be explained by the sharp (13 percent) drop of meat availability in the latter year, and the 6 point rise in IQ from 1935 to 1937/38 by a partial recovery of consumption. The rise of IQ for birth years after 1962 is associated with a nutritional rise as well as with a decrease in family size at birth.

Time-series regression using econometric procedures (Franke, 1980, pp. 1010-1013) shows that average IQ levels are related to earlier conditions of nutrition and family size:

Relative IQ = 136.47 + 0.42 Nutrition - 17.79 Family Size

t = 4.38 t = -3.45

(p = .0009) (p = .0048)

Variance Explanation = 79.53%, corrected = 76.12%;

Durbin-Watson Coefficient = 2.21 (no serial correlation).

The projection of IQ levels to the end of the twentieth century in Figure 1A indicates a further rise of intelligence quotient by nearly a standard deviation, as family size at birth continued to drop and protein consumption rose to relatively high levels in the 1970s and early 1980s.

In conclusion, it appears that during the baby boom the IQ decline for the population in general was similar to the decline in precollege aptitude scores for the same birth cohorts. This study supports Flynn's (1984, p. 48) observation that his gain data appear to show "the radical malleability of IQ" for a large population, and points to major shifts in

nutrition and in family size in early childhood which appear to have contributed to shifts in average IQ, as indices of protein availability and accessibility of parents for intellectual stimulation varied as much as 60 percent. Finally, there appears to be reason for optimism regarding the long-term rise of intellectual ability in the United States. Even with the declines of the depression and baby boom, average intelligence quotients of those born in the 1950s and 1960s are far higher than for births early in the century. If average family size and nutrition in early childhood remain predictive of IQ levels, then the average aptitude of those born toward the end of this century will rise as much again.

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Detailed results are presented in the full paper.